Meteoric Water Mobility Procedure
(MWMP)
Standardized Column Percolation Test Procedure

1. Scope

The purpose of the Meteoric Water Mobility Procedure (MWMP) is to evaluate the potential for dissolution and mobility of certain constituents from a mine rock sample by meteoric water. The procedure consists of a single-pass column leach over a 24 hour period using a mine rock sample to extraction fluid (effluent) ratio of 1:1. The extraction fluid is Type II reagent grade water[1].

2. Reference Documents

2.1 Meteoric Water Mobility Procedure, Bureau of Mining Regulation and Reclamation, Nevada Division of Environmental Protection, 9/19/90.

2.2 Standard Methods for the Examination of Water and Wastewater, 18th edition, APHA/AWWA/WEF, 1992, Method 1080.

3. Significance and Use

3.1 This procedure is intended as a means for obtaining extracts from mine rock samples. The extracts may be used to evaluate the final pH and release of certain constituents of mine rocks exposed to meteoric events.

3.2 The pH of the extraction fluid used in this procedure is to reflect the pH of precipitation in the geographic region in which the mine rock is being evaluated (in this case, the State of Nevada).

3.3 This procedure is designed to mobilize potential contaminants present in the solids, so that the resulting extract can be used to assess leachate which could potentially be produced from mine rock in the field.

3.4 This procedure produces extracts that are amenable to the determination of both major and minor (trace) constituents. When minor constituents are being determined, it is especially important that precautions be taken in sample storage and handling to avoid possible contamination of the samples.

3.5 This procedure may not be suitable for obtaining extracts from finely divided solids (such as clayey soils, sludges, mill tailings, etc.). An alternate extraction procedure may then be advised.

4. Apparatus

4.1 Extraction Device, PVC column of 15 cm (6") O.D. of sufficient height to contain a

minimum of 5 kg of minus 5 cm (2") mine rock sample and sufficient additional height to contain applied extraction fluid should blinding (ponding) occur (Approximately 8 kg of minus 5 cm solids per 30.5 cm of column height). For a 5 kg mine rock sample, a 15 cm O.D. x 45 cm high column is recommended. Additional column height will be required for mine rock sample quantities greater than 5 kg. The bottom of the column must be sealed (bubble cap) and a solution discharge outlet situated above the sealed bottom of the column and below the "punch plate". A drawing of the extraction device is appended.

4.2 Glass Wool (inert) - glass wool is placed onto the "punch plate" before loading the mine rock charge into the column to minimize fines migration and onto the top of the mine rock charge after column loading to aid even extraction fluid distribution.

4.3 Metering pump or constant head device to insure constant rate extraction fluid application

4.4 Extraction fluid (influent) and effluent containers sufficient in size to contain liquid used during extraction. Containers must be covered to avoid possible contamination from sources outside the test apparatus.

4.5 Laboratory balance capable of weighing to 1.0 g.

4.6 Drying pans or dishes for moisture content determinations.

4.7 pH meter with a readability of 0.01 units and an accuracy of ±0.05 units at 25°C.

4.8 Filtration assembly device of a composition suitable to the nature of the analyses to be performed and equipped with a 0.45 µm pore size filter. An assembly for prefiltration or centrifugation may be required if 0.45 µm filtration is difficult.

4.9 Tubing - surgical or Tygon tubing sufficient in diameter and length for the extraction device assembly (pump, column effluent outlet).

5. Reagents

5.1 Water, Type II reagent grade - Water purified by distillation, ion exchange, reverse osmosis, electrodialysis, or a combination thereof, conforming to the specifications for Type II reagent grade water[1].

6. Sampling (Field)

6.1 Field sampling should be accomplished to insure a representative mine rock sample is obtained.

6.2 The minimum quantity of mine rock sample required for the MWMP is 5 kg. At least 7 kg of mine rock sample should be submitted to the laboratory for feed moisture content determination, MWMP, and other potential analyses requested by the submitting company. Mine rock samples of up to 25 kg are appropriate for submittal.

6.3 It is important that the mine rock sample be representative with respect to surface area, as variations in surface area may directly affect the leaching characteristics of the

sample. Mine rock samples should contain a representative distribution of particle sizes.

6.4 Keep samples in closed containers (bags, buckets) appropriate to sample type and analysis for transport to the laboratory.

7. Sample Preparation (Laboratory)

7.1 Remove mine rock sample from the container and blend by coning or rolling and obtain sample for feed moisture content (approximately 1 kg).

7.2 Screen remainder (5 kg or more) on a 5 cm (2") screen. Save minus 5 cm material for subsequent recombination with crushed plus 5 cm material.

7.3 After screening, weigh plus and minus 5 cm screened materials and calculate plus and minus 5 cm weight distributions.

Ex: wt of +5 cm ÷ total ÷ wt × 100 = % plus 5 cm.

7.4 Crush (or hand break) plus 5 cm material to just pass a 5 cm (2") screen and recombine with the screened minus 5 cm material.

7.5 Thoroughly blend the recombined 100% minus 5 cm mine rock sample, and using the feed moisture content (7.1 above), calculate the dry weight of the sample to insure a minimum of 5 kg (dry weight) is available for the MWMP extraction (column percolation) test.

7.6 Load the 100% minus 5 cm mine rock sample into the extraction device (column). To minimize particle segregation and compaction during column loading, the sample shall be dropped from no more than 24 inches when introduced from the top of the column, and no tamping, shaking, or other methods to compact the sample will be employed.

8. Extraction Procedure

8.1 Adjust the extraction fluid application rate[2] such that the number of milliliters of water applied to the column in a 24 hour period will be equal to the number of dry grams of mine rock sample in the column.

Ex: 5000 g × (1 ml/1 g) × (1 hr/60 min) × (1/24 hr) = 3.47 ml/min

8.2 Measure and record the initial pH of the extraction fluid.

8.3 Begin metering the extraction fluid onto the top of the mine rock contained in the column at the predetermined rate.

8.4 When a volume equal to the mass of dry solids in the column has been delivered through the column (assume 1 ml/g), cease application of the extraction fluid[3]. *Note: The mine rock charge will retain water so extraction fluid application must continue until the target effluent volume (1:1 solids to effluent ratio) has been collected. This will require application time beyond 24 hours, but not to exceed 48*

hours.

8.5 Thoroughly mix the effluent immediately. Then procure sufficient quantity for the required analyses (usually Profile I or Profile II).

8.6 Measure and record the pH of the extract.

8.7 Filter[4] the sample through a 0.45 µm inert membrane to obtain extract for dissolved constituent analyses.

8.8 Preserve[5] the extract sample appropriately for the required analyses.

8.9 Allow the mine rock solids, after extraction, to drain until the surface of the sample no longer "glistens" and at least two minutes elapse between drops of effluent from the column.

8.10 Remove the mine rock residue (solids) from the column and take a representative portion for residual moisture[6] determination.

8.11 Blend and split the moist mine rock residue to obtain samples for additional analysis if necessary.

8.12 If it is evident at Step 8.3 that the particle size of the sample (finely divided solids such as clayey soils, sludges, mill tailings, etc.) is not allowing reasonable percolation of the extraction fluid to occur, aborting the extraction procedure and submitting the sample to an alternate extraction procedure may be advised.

9. Reporting (record and report the following to NDEP)

9.1 pH of extraction fluid (influent).

9.2 pH of effluent after extraction.

9.3 Total dry weight of mine rock sample used for MWMP.

9.4 Feed and retained (after extraction and draining) moisture contents.

9.5 Time of contact in the extraction device.

9.6 Procedures (synopsis) used for MWMP extraction, effluent filtration, and extract preservation.

9.7 Results of Profile I or Profile II analyses on extract.

[1] Standard Methods for the Examination of Water and Wastewater, 18th edition, APHA/AWWAfWEF, 1992, Method 1080.

Based upon data collected for wet depositions in Nevada, obtained from Desert Research Institute, University of Nevada System, Type II reagent grade water most closely simulates meteoric water in Nevada in terms of both composition and pH range. Personal communication, M.N. Shen with Rick Stone, June 1995.

[2] The extraction fluid can be metered via variable speed delivery devices such as peristaltic

pumps or diaphragm pumps. A constant hydraulic head device can be used wherein a single speed pump delivers the extraction fluid to an elevated vessel which is equipped with an overflow back to the extraction fluid reservoir. The constant head vessel is tapped at the bottom to supply extraction fluid to the extraction column. A variable pinch clamp or screw clamp can be used to control the rate of extraction fluid application to the column.

[3] The effluent container can be calibrated so as to overflow after the desired volume of extract has been collected. For example, if a 5 kg charge of solids is used, a 5 L vacuum flask can be used as receiver. Sufficient inert glass beads can be added to the vessel to cause overflow when 5 L of extract has been received. Therefore a technician need not be available at the exact time the target effluent volume has been achieved.

[4] If the effluent contains finely divided suspended matter, filtration may be difficult. It is suggested that in such cases filtration through a 0.45 µm membrane be preceded by centrifugation and/or prefiltration using a larger pore glass fiber filter.

[5] An aliquot for metals analysis must be preserved with reagent grade nitric acid to pH <2. An aliquot for phosphorous and nitrate analysis must be preserved with reagent grade sulfuric acid to pH < 2. An aliquot for cyanide analysis must be preserved with reagent grade sodium hydroxide to pH > 12. All other analytes required in Profiles I and II require only that the sample be stored without preservative at 4 ±2°C.

[6] Residual moisture can be determined by placing a representative portion of the moist mine rock residue (following step 8.9) into a pre-weighed beaker or similar vessel. The sample is then placed in an oven controlled at 105 ±2°C overnight, or until the difference between weighings at 30 minute heating intervals is less than 0.1%. The difference between wet and dry weights divided by the wet weight and multiplied by 100 yields the percent residual moisture. [(wet wt. - dry wt.)/wet wt.] 100 = % RM

COLUMN PERCOLATION EXTRACTION DEVICE
(METEORIC WATER MOBILITY PROCEDURE)